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DEPARTMENT OF THE INTERIOR

UNITED STATES BUREAU OF MINES
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CONSUMPTION OF PRIMARY AND SECONDARY TIN IN THE UNITED STATES IN 1935

BY

E. W. PEHRSON, JOHN B. UMHAU, AND M. E. TROUGHT

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By E. W. Pehrson 2/, John B. Umhau 3/, and M.E. Trought 4/

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INTRODUCTION

In making any canvass of secondary metals great care must be exercised to avoid duplication or exaggeration of net consumption. One of the major difficulties is to trace the metal accurately as it passes through the many cycles of manufacture. Greater or less duplication probably occurs in any canvass.

The manufacturer of tin plate, for instance, purchases primary pig tin exclusively as a raw material. Most of it goes into the coating on the steel sheet, but a substantial part emerges in the form of byproducts such as scruffs and drosses. These are sold to other plants, where they are used in the manufacture of alloys and chemicals. Alloys and chemicals, however, are not necessarily articles for final consumption. The alloy may be sold in ingot form to a bearing manufacturer, who, in turn, may produce some scrap which he may sell to still another plant that may make still other products. There is a considerable return of tin in the form of waste products from chemicals sold to the silk industry. Even tin plate does not represent an ultimate use of tin because the tin-can maker produces large amounts of clippings, which are sold to detinning plants, where the tin is recovered and used again for some other purpose. Thus the degree of duplication in consumption statistics depends on the point in the industrial cycle where consumption is measured.

In studies of this kind it is difficult to classify metal as primary or secondary. Obviously all tin in use was originally primary. The problem, then, is to determine when it becomes secondary metal. Examination of the literature indicates that tin derived from old scrap, such as old solder from worn-out automobile radiators, old type metal, etc., is universally regarded as secondary metal. There is no general agreement, however, as to the status of tin reclaimed from new scrap, that is, the byproducts of primary-tin manufacturing operations. Frequently a distinction is made on the basis of whether the new scrap is treated in the same plant in which it is made or whether it is sold elsewhere for treatment. In the first instance the recovered tin still may be considered as primary metal and the treatment of the scrap as merely a step in the process of manufacture. In the second instance, where the scrap has undergone change of ownership or title, the recovered tin may be regarded as secondary metal. Since there is no well-recognized point at which primary metal becomes secondary metal, any definition established is of necessity arbitrary; but if we are to measure consumption of primary and secondary metal some definition is essential.

In the present study an attempt has been made to measure consumption in terms of finished products made by the initial tin fabricators, that is, concerns that purchase raw materials, such as virgin and secondary pig tin or tin scrap, and convert them into tin plate, alloys, and chemicals. Companies that purchase alloys, chemicals, or tin plate for further manufacture are not included. The total tin consumption reported herein, therefore, includes duplication to the extent that initial fabricators purchase and rework the waste products of the second and third cycle of fabrication. This duplication cannot be expressed in tons as the initial fabricators are una

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segregate their purchases of industrial (new) scrap and old scrap (junk). The questionnaire submitted to consumers contained no definition of secondary metal; but, owing to the accounting procedure used, the secondary tin reported represents purchased material or tin derived from scrap that has undergone change of title. This definition is not entirely satisfactory for the reason that some primary metal enters the initial cycle of fabrication and emerges therefrom as secondary metal in finished products. This is due to intercompany transactions in primary scrap.

About 950 concerns, including tin-plate mills, secondary-metal refiners, detinning plants, and other consumers of pig and scrap tin assisted in this survey. The Bureau of Mines acknowledges their cordial cooperation with appreciation.

GENERAL SUMMARY

Tin products containing 70,962 long tons of tin were produced in the United States in 1935 according to reports received by the Bureau of Mines from 947 concerns that used pig or scrap tin in that year. Of the total quantity used, 55,779 tons were primary or virgin tin and 15,183 tons were secondary tin as defined in the introduction to this report. A résumé of the total tin input and output of the tin-consuming industry follows:

	Long tons
Tin on hand January 1, 1935	16,579
Add net purchases during year	71,188
Available for use	87,767
Less tin on hand December 31, 1935	14,649
Total tin processed during year	73,118
Deduct intercompany transactions in scrap (tin content)	1,805
Total tin consumed in manufacturing	71,313
Deduct plant losses	351
Tin content of manufactured products	70,962
Primary tin 1/	55,779
Secondary tin	15,183

1/ Total input of primary pig tin into industry in 1935, as determined by purchases plus reductions in consumers stocks, amounted to 57,503 tons. The difference between this figure and the 55,779 tons shown here is due principally to sales of scrap by initial fabricators of primary tin and to a minor extent to losses of tin in process of manufacture.

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Purchases

The tin-consuming industry purchased its tin requirements in 1935 in the following forms:

	Long tons
Primary pig tin	55,433
Secondary pig tin	2,217
Scrap (tin content)	13,538
	71,188

The purchase of 55,433 tons of primary pig tin as reported to the Bure of Mines by 795 consumers is equivalent to nearly 94 percent of deliveries of primary tin in the United States as reported by Commodity Exchange, Inc. The difference may be due to errors in reports submitted to the Bureau of Mines, incomplete coverage by the Bureau of Mines canvass, or to accumulations of stocks by nonconsumers. Of these concerns 193 purchased more than 15 long tons (approximately one minimum carload). Of the balance, 102 concerns purchased between 5 and 15 tons; and the rest, about 63 percent of th entire number, purchased less than 5 tons in the year.

Purchases of tin in the form of scrap include about 3,200 tons (mostly in tin-plate clippings) that were consumed at detinning plants.

Stocks

Tin on hand at consumers' plants at the beginning and end of the year was in the following forms (in long tons):

	January 1	December 31
Primary pig tin	9,749	7,679
Secondary pig tin	455	291
Tin in scrap	2,351	2,281
Tin in process of manufacture	4,024	4,398
Total	16,579	14,649

The sharp decline in stocks of primary pig tin reflects the shortage virgin supplies during 1935. Total stocks, including tin in process of ma facture, were equivalent to only a 2-month supply at the end of the year. Visible stocks of virgin tin on hand in the United States at the end of 19 as reported by Commodity Exchange, Inc., would have provided less than a h month additional supply. Over half of the tin in process of manufacture w in the melting pots at the tin-plate mills.

Tin content of scrap

In the manufacture of tin products a substantial part of the tin that enters the manufacturing process emerges in the form of byproducts, such a drosses and clippings. At some plants these materials are merely re-treat or refined and returned to the system. This has been considered herein as step in the process of manufacture, and the tin so recovered has not been

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counted twice in the consumption tabulation. Some byproducts, however, are sold to other consumers, who report them as purchases of scrap; and since the seller likewise has accounted for this tin it is necessary to deduct these intercompany transactions to avoid duplication. In 1935 the total amount of tin involved in sales of scrap was reported at 1,805 tons by concerns that accounted for about 70 percent of the total tin processed. The remaining concerns either failed to report this item or had no sales.

In addition to the scrap shipped from plants a considerable quantity was treated in the home plant. The quantity of tin recovered from the treatment of home scrap, as reported by concerns that represent by far the greater part of the total tin processed during 1935, was approximately 5,000 tons. Many plants do not re-treat their own scrap.

The total yield of scrap in processing 73,118 tons of primary and secondary tin in 1935 contained, roughly, 7,000 tons of tin, of which 5,000 tons were re-treated in the home plant and 2,000 tons were sold. The scrap yield from plants beyond the first stage of manufacture, such as tin-can factories and silk mills, is not included in these figures.

Plant losses

Under this heading is included only the tin actually lost beyond recovery in the various processes connected with the initial fabrication of pig and scrap tin. Losses in plants that operate on pig tin exclusively apparently are very small. In the manufacture of tin plate, for instance, the actual volatilization and mechanical loss amounted to 0.12 percent of the total tin processed. Many plants reported losses as negligible, and others had no record of this item. Data obtained on tin losses from plants that use scrap were not satisfactory. The total reported by all plants exclusive of the tin-plate mills was 314 tons, equivalent to less than 0.8 percent of the metal processed. It is believed that this is a considerable understatement of actual losses.

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CONSUMPTION OF TIN BY USES

The following table shows the consumption of primary and secondary tin by uses in 1935:

Use of tin in 1935

Uses	Tin content of finished product in long tons		
	Total	Primary	Secondary
Tin plate	27,290	27,290	---
Terneplate	1,012	208	804
Solder	16,646	9,736	6,910
Babbitt	5,144	3,665	1,479
Bronze	4,765	2,608	2,157
Collapsible tubes	3,548	3,548	---
Chemicals (other than tin oxide)	3,205	626	2,579
Tinning	2,082	2,080	2
Foil	1,629	1,602	27
Tin oxide	1,249	1,074	175
Type metal	1,003	163	840
Pipe and tubing	953	950	3
Galvanizing	620	620	---
Miscellaneous alloys	481	422	59
White metal	397	347	50
Bar tin	395	368	27
Miscellaneous	543	472	71
Total	70,962	55,779	15,183

Tin plate and terneplate

The tin-plate and terneplate industry is by far the largest consumer of tin in the United States. In 1935 it accounted for about 50 percent of the total purchases of primary tin and 49 percent of the primary tin contained in finished products. All of the tin required for the manufacture of tin plate and 16 percent of that required to produce terneplate was purchased as primary metal; 84 percent of the tin used in terneplate was acquired in the form of secondary tin alloy. Further details as to the use of tin in this industry are presented in the appendix, Consumption of Tin in the Tin-Plate and Terneplate Industry.

Solder

Solder, the second largest use of tin, accounted for 17 percent of the total primary and 46 percent of the total secondary tin consumption in 1935. Of the total tin used for this purpose 58 percent was primary, and 42 percent was secondary. A large part of the latter was reclaimed from old automobile radiators. Solder produced in 1935 varied considerably in composition. The tin content ranged from 24 percent to 69 percent, the average being about 3 percent.

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Babbitt

Seven percent of the primary and 10 percent of the secondary tin was used in babbitt in 1935. The tin content of the alloy reported under this item in 1935 ranged from 1 to 93 percent and averaged about 37 percent.

Bronze

Bronze accounted for 7 percent of the total tin used in 1935 - 5 percent of the primary tin and 14 percent of the secondary tin. The tin content of bronze is very low, having averaged only 3 percent in 1935.

Collapsible tubes

Collapsible tubes ranked as the fourth largest use of primary tin in 1935, accounting for 5 percent of the total. Virgin tin is used exclusively in this industry, and the 3,548 tons reported for 1935 compares favorably with the 3,826 tons used in 1930.

Chemicals

The tin chlorides are the principal items in this group, which includes all chemicals except tin oxide. These chemicals are used largely in the silk industry and are made chiefly from tin-plate scrap. A considerable part of the tin in chemicals used by the silk industry is returned to the secondary refiners in waste products.

Tin oxide

Tin oxide is used primarily as a constituent in the enamels applied to sanitary ware, cooking utensils, refrigerators, etc. It is made chiefly from primary pig tin.

Tinning

Virtually all tinning is done with virgin tin. The following is a partial breakdown of the tin used for this purpose in 1935.

Articles tinned	Long tons
Wire	594
Food-preparation equipment	594
Tubes, sheets, and shells	220
Undistributed and other	674
	2,082

Foil

Tin foil is also made largely from primary tin, although some secondary pig tin was used in this industry in 1935. The use of tin foil has been affected adversely by substitution of aluminum foil and cellophane.

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Type metal

Type metal flows back and forth from manufacturer to printing plants in a virtually closed circuit. Only enough new metal is added each year to bring the reworked metal up to proper composition and to provide for new consumers. A large part of the secondary tin used in type metal in 1935 th was derived from old type returned to the factory for refining.

Pipe and tubing

Since the 18th Amendment was repealed more tin has been used in the ma facture of pipe and tubing. Tin pipe is used extensively in the brewing an dispensing of beer. A tin-lined pipe has been developed as a cheaper subst tute for pure tin pipe, but in 1935 only 13 tons of tin were used for this purpose.

Galvanizing

Addition of tin to the zinc bath used in galvanizing is said to improv greatly the spangle effect on the finished products. Apparently this use o tin has increased considerably, 620 tons were reported used for this purpose in 1935 compared with 107 tons in 1930 and 133 tons in 1928.

Miscellaneous alloys

This group, which includes all alloys except solder, babbitt, bronze, and white metal, comprises largely a variety of special products, such as organ-pipe metal, fusible plugs, cable coverings, miscellaneous aluminum alloys, dental alloys, etc.

White metal

Of the 397 tons of tin used to make white metals in 1935, 239 tons (211 primary and 28 secondary) were used in Britannia metal. The rest was used in pewter and various novelty metals.

Bar tin

Three hundred and ninety-five tons of primary and secondary pig tin were remelted and cast into small shapes for small consumers in 1935.

Miscellaneous

This item includes various products that could not be combined with listed above. It also contains a small amount of tin for which the consumers failed to specify the use. The principal products included under this heading are tin powder, tin sand, tin packing, and molds used in the rubber industry.

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CONSUMPTION OF TIN IN THE TIN-PLATE AND TERNEPLATE INDUSTRY IN 1935 5/

The following summary of tin consumption by the 18 concerns that produced tin plate and terneplate in 1935 is released in advance of a final report now being prepared by the Bureau of Mines for the entire tin-consuming industry.

SUMMARY

	Long tons
Total tin on hand January 1, 1935	8,405
Add net purchases during year	28,778
Available for use	37,183
Less tin on hand December 31, 1935	6,722
Total tin processed during year	30,461
Deduct tin content of scrap shipped from plant	1,016
Total tin consumed in manufacturing	29,445
Deduct plant losses	37
Tin content of manufactured products	29,408
Tin plate	27,290
Terneplate	1,012
Other products	1,106

Purchases

The tin and terneplate industry purchased its tin requirements in 1935 in the following forms:

	Long tons
Virgin pig tin	27,927
Tin in terne metal	851
Total	28,778

No purchases of secondary pig tin were reported in 1935. The tin purchased as terne metal represented 84 percent of the total tin used in the manufacture of terneplate.

Stocks

Tin on hand at the beginning and end of the year was in the following forms:

	January 1	December 31
Virgin pig tin	5,850	4,007
Tin in terne metal	124	147
Tin in plant scrap	187	273
Tin in process of manufacture	2,244	2,295
Total	8,405	6,722

5/ Mineral Market Reports M.M.S. 482, Aug. 5, 1936.

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The sharp reduction in stocks during 1935 reflected the shortage of tin supplies that prevailed during most of the year. Depleted stocks in consumers' hands together with the unusually low visible supply emphasized the strategic position of the United States in tin. Unmelted metal on hand on December 31 at tin-plate and terneplate plants was scarcely sufficient for 2 months' operation. Working stocks of molten metal barely would have provided another month's operation and the entire visible supply of tin in the United States at the end of the year would have provided only an additional month's operation. Thus, if our tin supply had been cut off suddenly at the end of the year this important industry would have had less than a 4 months supply of tin in sight.

Tin content of scrap

In the manufacture of tin plate and terneplate a large portion of the tin melted emerges in the form of byproducts, such as scruffs, drosses, and other scrap. Most of these materials are re-treated at the tin-plate mills and the tin recovered therefrom is returned to the system. This is considered merely as a step in the process of manufacture and the tin so returned has not been counted twice. Some byproducts, however, are sold to detinning plants and secondary smelters, which, in turn, use them usually in the manufacture of other products such as chemicals, solder, and babbitt. Although this tin passes through the tin-plate mills, eventually it is actually used for other purposes and therefore cannot be considered as consumed in the manufacture of tin plate and terneplate.

In processing 30,461 tons of tin in 1935, byproducts containing 5,529 of tin were produced, of which 4,513 tons were recovered and reused at the plate plants and 1,016 tons were shipped away in scrap. Some of the tin in the scrap shipped may have returned, but if so the tin-plate producers apparently have considered it as a purchase of virgin tin as no purchases of secondary pig tin were reported.

Plant losses

Under this heading is included only the tin actually lost in manufacturing operations at the tin-plate and terneplate plants. Losses incident to refining this industry's byproducts at secondary smelters have not been credited to tin consumption in tin-plate and terneplate manufacture.

The quantity of tin lost in the manufacture of tin plate and terneplate is very small and includes chiefly volatilization and mechanical losses. Some plants had no record of their losses and others reported the item as negligible. Although individual plant losses varied considerably the experience of the plants that submitted data indicated an average loss of 0.12 percent of the total tin processed. Since this tin is never recovered it is considered as having been consumed in the tin-plate and terneplate industry.

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TIN CONTENT OF PRODUCTS MANUFACTURED AT TIN-PLATE AND TERNEPLATE PLANTS

The net tin content of all products manufactured by the tin-plate and terneplate industry in 1935 was 29,408 tons and consisted of 28,604 tons of virgin pig tin and 804 tons purchased in terne metal. In addition to tin plate containing 27,290 tons of tin and terneplate containing 1,012 tons, this industry produced other products that contained 1,106 tons of tin.

Tin plate

The following table shows the quantity and tin content of the various grades of tin plate manufactured in 1935.

Tin plate	Quantity manufactured, long tons	Tin content (all virgin)	
		Total long tons	Pounds per long ton of tin plate
Cokes:			
Standard.....	1,649,109	25,921	35.2
Special.....	40,366	671	37.2
Best.....	10,391	193	41.6
Total.....	1,699,866	26,785	35.3
Charcoals.....	20,577	505	55.0
Total tin plate...	1,720,443	27,290	35.5

Terneplate

The following table shows the quantity and tin content of terneplate made in 1935 and its tin content.

Terneplate	Quantity manufactured, long tons	Tin content (long tons)			Pounds of tin per ton of terneplate
		Total	Virgin	Tin purchased as terne metal	
Short ternes..	81,413	591	156	436	16.3
Long ternes...	101,777	421	52	368	9.3
Total	183,190	1,012	208	804	12.3

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Other products

In addition to tin plate and terneplate the industry produced a variet of other products in 1935, the tin content of which is shown below.

Use or product	Tin content (all virgin), long tons
Galvanized sheets	530
Tinning	293
Brass and bronze	142
Babbitt metal	115
Solder	9
Other alloys	1
Miscellaneous	16
Total	1,106

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